

REMARKS

Claims 1-3, 6-11 and 21-27 remain in the application. Claims 4 and 5 have been canceled. Claims 21-27 are new claims

Claim Rejection – 35 U.S.C. § 102(e)

Claims 1-6, 8, & 9 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Publication No. 2002/004712 by Reid (“Reid”). The rejection is respectfully traversed.

Claim 1 is patentable over Reid at least for reciting: “depositing a capping layer over a metallization level” and “the metal serving as the first interconnect line and a via connection to a second interconnect line in the metallization level.” Reid does not pertain to formation of interconnect lines in integrated circuits. Consequently, in Reid, there is no capping layer deposited over the final metal layers 41a and 41b (Reid, FIG. 2B). In Reid, sacrificial layer 42, not a capping layer, is deposited over the metal layers 41a and 41b. Furthermore, Reid does not disclose or suggest another metal layer over 41a and 41b that serves as a via connection **and** interconnect line to either metal layers 41a or 41b. In Reid, the metal layers 41a and 41b are **final** metallization layers (Reid, paragraph [0023]. Again, this is primarily because the gist of Reid is the formation of a micro-mechanical device, not integrated circuits.

Therefore, claim 1 is patentable over Reid. Claims 2, 3, 6, 8 and 9 depend on claim 1, and are thus patentable over Reid at least for the same reasons that claim 1 is patentable.

New claim 21 is patentable over Reid at least for reciting: “forming a via and an interconnect line pattern in the sacrificial layer” and “etching the sacrificial layer using a noble gas fluoride etchant to form the air core between the first metallization level and the second metallization level.” Because Reid does not pertain to dual damascene processes, Reid does not disclose or suggest forming a via and an interconnect line pattern in the sacrificial layer. In Reid, plug 44 is only in a via, not serving as an interconnect line (Reid FIG. 2C, paragraph [0024]). Furthermore, Reid does not disclose

or suggest formation of an air core between a first metallization level and a second metallization level. In Reid, the "air core" is between metal layers 41a and 41b and a micro-mechanical portion of a MEMs device, not a metallization level (Reid, FIG. 2F).

Therefore, claim 21 is patentable over Reid. Claims 22-27 depend on claim 21 and are thus patentable over Reid at least for the same reasons that claim 21 is patentable.

Claim Rejection – 35 U.S.C. § 103(a)

Claims 1-11 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,555,467 to Hsu et al. ("Hsu") in view of U.S. Patent Application Publication No. 2003/0073303 by Huibers ("Huibers"). The rejection is respectfully traversed.

Huibers has a filing date of October 11, 2002 and claims the benefit of a provisional application filed October 12, 2001. Because the present application has a filing date of February 7, 2002, Huibers is not prior art to the present application unless portions of Huibers cited in the last office action are also disclosed in the provisional.

Claim 1 is patentable over Hsu and Huibers at least for reciting: "forming an opening through the sacrificial layer, the support layer, and the capping layer" and "etching the sacrificial layer using a chemistry that includes a noble gas fluoride to create the air core over the metallization level." Hsu does not disclose or suggest the use of a noble gas fluoride to etch a sacrificial layer and create an air core over a metallization level. This is because the gist of Hsu is the use of a **sacrificial polymer** (copolymer of butylnorbornene and triethoxysilyl norbornee) that is converted to air gaps during annealing (Hsu, Abstract, Summary of the Invention). The last office action suggests that it would be obvious to replace Hsu's sacrificial polymer with silicon as taught by Huibers. Applicants respectfully disagree with this conclusion.

Firstly, the proposed combination significantly changes the principle of operation of Hsu as it replaces Hsu's inventive use of a sacrificial polymer with another material not disclosed or suggested by Hsu. See MPEP 2143.01. Secondly, Hsu's process does not disclose or suggest a separate etchant to remove the sacrificial polymer. In Hsu, the

sacrificial polymer is decomposed to form air gaps during annealing or a dry etch process using oxygen plasma (Hsu, col. 1, lines 39-40; col. 3, lines 12-17). There is no disclosure in either Hsu or Huibers that a silicon sacrificial layer can be decomposed during an annealing step or a conventional dry etch process. There is also no disclosure in either Hsu or Huibers that a silicon sacrificial layer, and its etching, is compatible with the rest of Hsu's process and structures. For at least these reasons, it is respectfully submitted that Hsu and Huibers do not render claims 1-11 obvious.

Nevertheless, to expedite prosecution, claim 1 has been amended to recite inventive features not disclosed or suggested in Hsu and Huibers. Claim 1 now recites that a capping layer is over the metallization level, the support layer is over the capping layer, and the sacrificial layer is over the support layer. Furthermore, claim 1 now recites that the opening in which the metal is deposited is through the sacrificial layer, the support layer, and the capping layer. These features of claim 1 and their advantages are disclosed in the specification at least on page 5, lines 3-19 and FIGS. 1E and 1F. Hsu and Huibers do not disclose or suggest the recited capping layer, support layer, sacrificial layer, and opening. For example, in Hsu, sacrificial layer 18 (cited in the last office action as a "support layer") is actually a sacrificial layer that is subsequently removed (Hsu, col. 3, lines 23-38). That is, Hsu sacrificial layer 18 does not support a subsequently formed interconnect line as required by claim 1.

For at least the above reasons, claim 1 is patentable over Hsu and Huibers. Claims 2, 3, and 6-11 depend on claim 1, and are thus patentable over Hsu and Huibers at least for the same reasons that claim 1 is patentable.

Claim 21 is patentable over Hsu and Huibers at least for reciting: "depositing a support layer over a first metallization level of the integrated circuit, the support layer being configured to provide structural support to a subsequently formed interconnect line in a second metallization level after an air core is formed over the first metallization level; depositing a sacrificial layer over the support layer; forming a via and an interconnect line pattern in the sacrificial layer." Hsu and Huibers do not disclose or suggest the recited support layer, among other features of claim 21.

Claims 22-27 depend on claim 21, and are thus patentable over Hsu and Huibers at least for the same reasons that claim 21 is patentable.

Conclusion

For at least the above reasons, it is believed that claims 1-3, 6-11 and 21-27 are in condition for allowance. The Examiner is invited to telephone the undersigned at (408)436-2112 for any questions.

If for any reason an insufficient fee has been paid, the Commissioner is hereby authorized to charge the insufficiency to Deposit Account No. 50-2427.

Respectfully submitted,
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